Experimental Study of Improving Wireless Propagation Channel by Using Reflectarray

Qiang Chen

Tohoku University

1. Introduction

The radio wave from base stations of cellular mobile communications may be blocked by high buildings in urban areas, resulting in some None-Line-of-Sight (NLOS) areas. These areas become blind spots, or blind areas to the wireless service, particularly in narrow streets between high buildings because of low signal to noise (SN) ratio in these areas. This problem becomes much more serious when higher and higher frequency band is assigned to the cellular mobile communications in the near future. We have considered to mount a reflectarray on the wall of these high buildings as a passive reflector to scatter the incident wave from the base station to the blind spots or areas to improve the SN ratio. This approach is also expected to increase the path number of incident wave to increase the channel capacity for a multi-input multi-output (MIMO) systems [1]. In this report, it is demonstrated that the experimental study was carried out to investigate the performance of the reflectarray to find if the reflectarry approach is effective in solving the problem of blind spots as well as in improving the channel capacity of MIMO transmission.

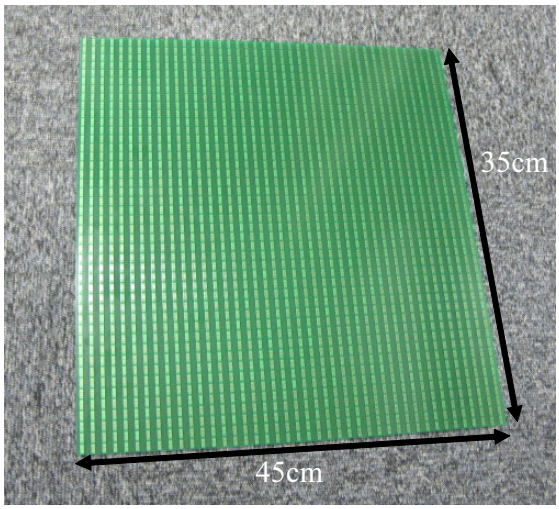

Fig. 1 A prototype of designed reflectarray for 11 GHz application.

2. Experiment and results

We have developed a reflectarray whose prototype is shown in Fig. 1. The reflectarray is composed of dipole elements loaded with an interdigital gap for adjusting reflection phase [2]. The reflectarray operates

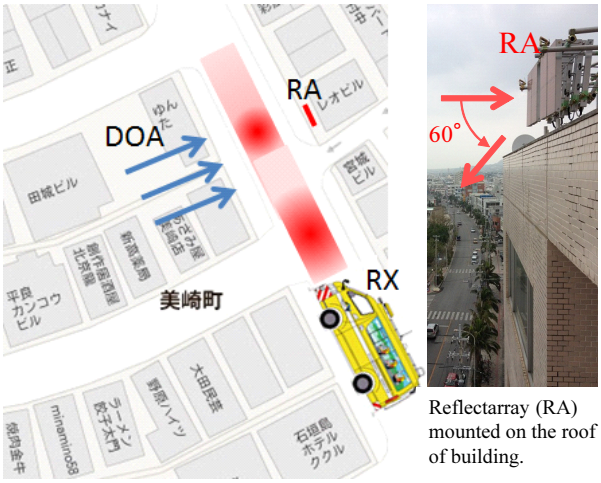

Fig. 2 Measuremental Environment.

at 11 GHz, and has a up-to 60° scattering angle to the normal incident.

The experiment was carried out using frequency of 11 GHz in Ishigaki-jima of Japan for the frequency license limitation. Fig. 2 shows the experimental environment. A reflectarray of 135 cm by 70 cm, which was composed of 2 by 3 reflectarray panels shown in Fig. 1, was mounted on a 9-floor building of about 23-meter height. The transmitting and receiving system are made by MEDAV (RUSK MIMO channel Sounder, 8 × 8, 100 MHz bandwidth). Transmitting antennas are sleeve antennas with vertical polarization installed 200 m away from the reflectarray. The receiving antennas installed on the top of a car are microstrip patch antennas with horizontal polarization and the car was moving along the street in front of the building where the reflectarray was mounted. For the blockage of buildings, it is a typically NLOS environment between the transmitting antenna and the receiving antenna in the street. It was shown from the measurement that the received power level (Fig. 3) and capacity of 8 × 8 MIMO (Fig. 4) in about 2-meter area in front the building installed with RAs are improved by 10 dB and 4 bps/Hz, respectively [3].

3. Conclusions

Reflectarray antennas were used to improve wireless propagation channel in none-line-of-sight (NLOS) environment. Experiments for the elimination of blind spots propagation channel and enhancement of MIMO

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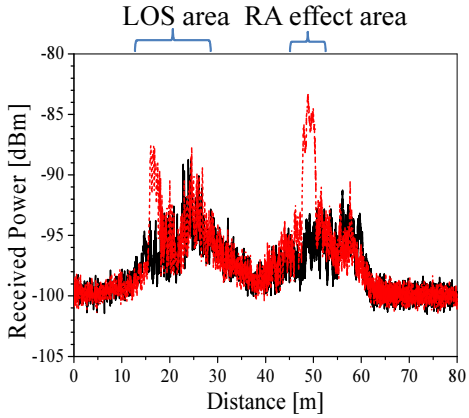

Fig. 3 Receiving field level before and after the mount of reflectarray.

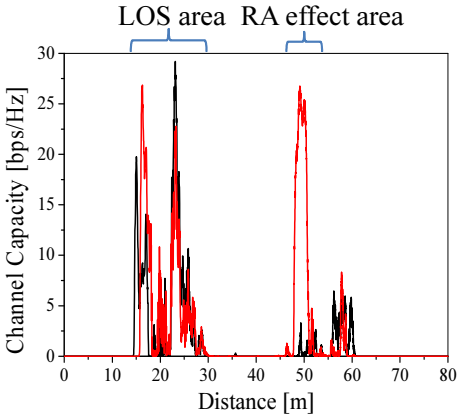

Fig. 4 8×8 MIMO channel capacity before and after the mount of reflectarray.

performance were investigated. It was demonstrated that the reflectarray can be used to enhance the communication quality and increase the multipath richness for MIMO communications.

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References

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